

EMGT 835 FIELD PROJECT:

Implementing Scrum in Distributed Teams

By

Muhammad Bhatti

Master of Science

The University of Kansas

Spring Semester 2012

An EMGT Field Project report submitted to the Engineering Management Program and the Faculty of the Graduate School of The University of Kansas in partial fulfillment of the requirements for the degree of Master of Science.

Mr. Herb Tuttle
Committee Chair

Mr. Raymond Dick
Committee Member

Mr. Khaled Ahmad
Committee Member

Date Accepted

Table of Contents

Table of Figures.....	3
Acknowledgements.....	4
Executive Summary	5
1. Introduction	7
1.1 Overview	7
1.2 ABC Telecom.....	8
1.3 Challenges	8
2. Literature Review	9
3. The Scrum Methodology	14
3.1. Scrum Roles	16
3.1.1. Product Owner	16
3.1.2. Scrum Master	17
3.1.3. Team	18
3.2. Scrum Artifacts	19
3.2.1. Product Backlog.....	19
3.2.2. Sprint Backlog	20
3.2.3. Burn Down.....	22
3.3. Scrum Meetings.....	22
3.3.1. Sprint Planning Meeting	22
3.3.2. Daily Scrum	23
3.3.3. Sprint Review Meeting	23
3.3.4. Sprint Retrospective.....	24
4. Scrum Application at ABC Telecom.....	26
4.1. Threats.....	26
4.1.1. Overall Economic Conditions.....	26
4.1.2. Competition.....	26
4.1.3. Productivity and Cost Efficiency	26
4.1.4. Innovation	27
4.2. Initiatives.....	27
4.2.1. Offshore Development.....	27
4.2.2. Smart Development	28
4.3. Implementing Distributed Scrum	29
4.3.1. Challenges.....	29
4.3.2. Solution	37
5. Summary.....	47
6. Suggestions for Additional Work.....	49
7. References	50
8. Appendix A.....	52
8.1. Acronyms and Definitions	52

Table of Figures

Figure 1 - Scrum Flow (Schwaber 2005).....	14
Figure 2 - Agile Manifesto (Beck 2001).....	15
Figure 3 - Scrum Relationships (Reynold 2010)	18
Figure 4 - Product Backlog (Reynold 2010).....	20
Figure 5 - Sprint Backlog (Reynold 2010)	21
Figure 6 - Sprint Backlog tasks on the wall (Deemer 2010).....	21
Figure 7 - Burndown Chart (Reynold 2010).....	22
Figure 8 - Scrum Methodology (Reynold 2010).....	25
Figure 9 – Communication Richness Scale (Deemer 2010).....	37
Figure 10 - Conference Room Set Up for Live Meetings (Deemer 2010)	39

Acknowledgements

Thank you to my wife Huma, my daughter Amna, and my son Osama; their patience with me while I was working on this research was incredible. They supported and encouraged me throughout my studies at the University of Kansas.

I am thankful to my field project committee chair, Mr. Herb Tuttle for his insight and guidance for my project. I would like to extend special thanks to my project committee, Dr. Raymond Dick, and Mr. Khaled Ahmad for their comments and helpful suggestions. I appreciate their extra time and commitment to support my academic success.

I am greatly thankful to the product owner and the scrum master at my organization for assisting me in completing this project.

I would also like to thank Parveen Mozaffar for her support during all these years.

Executive Summary

A strict project management approach for product development is costing ABC Telecom time and money. The approach, known as the waterfall model enforces completing one phase (e.g. planning) before moving to the next phase (e.g. development) and it is very rare to revisit the phase once it is completed. This approach has limited ABC Telecom's ability to realize the value of the project until the end. A waterfall model restricts the company's ability to identify the issues at an earlier stage because testing is done in the later stages of the product development. Customer feedback is not known until the product goes into production and any changes suggested by the customer at that time means the work will need to be redone, which results increase in project time, cost, and low customer satisfaction. Furthermore, the project manager is the one making all the decisions without any input from the development team, which makes the project more risk prone.

Based on research, ABC Telecom decided to adopt an alternative approach called "Scrum" in which the product is delivered as a series of functional features. The scrum framework focuses on the quality of deliverables. The tasks identified at the beginning of each iteration are expected to be fully tested and working at the end of the iteration according to customer expectations. This approach helps to accommodate changes more easily as the customer feedback is received earlier, helps provide better estimates, and encourages team members to take the tasks and provide their input.

The challenge in using scrum is applying scrum methodology to projects with distributed teams. In distributed teams, team members are located across the continents and have different cultures, time zones, and ethnic backgrounds. The distance between team members presents the challenge of building an environment of trust, ensuring open communication, managing artifacts, and scheduling meetings, which if not managed properly, can jeopardize the project.

ABC Telecom's product development team is a distributed team, with members in the US and India. The author, through research and experience as a software developer with ABC Telecom, lays out an approach that shows how scrum methodology can be used effectively with distributed teams and achieve the goals of bringing new products first to market and meeting customers' satisfaction.

1. Introduction

1.1 Overview

At ABC Telecom, a strict project management approach known as waterfall is followed for product development in which tasks are performed in a particular sequence. In this approach, each stage is completed before moving on to the next stage. The project team first completes the analysis phase to prioritize the business needs. Next is the design phase, during which business requirements are translated into system requirements. The design phase is followed by implementation and testing of the product developed. The last stage includes evaluation and maintenance of the product to make sure it runs smoothly after it is handed over to the customer.

The problem ABC Telecom is encountering with this approach is when the customer asks for any changes or enhancements to the existing product. It is nearly impossible to accommodate any changes, and the whole process has to start over again from the beginning. This delay increases the overall cost of the project and decreases customer confidence in the company to produce product with desired features on time.

As a result of research findings, ABC Telecom decided to adopt a new technique called scrum, an iterative, incremental framework for product development in which requirements are prioritized into manageable work items. The highest priority task is completed first. The product is delivered in predefined and agreeable releases. Customer feedback is quick and any changes or updates requested by the customer are easy to accommodate.

1.2 ABC Telecom

ABC Telecom is a global communications company providing a range of communications products and services. As of December 31, 2007, ABC Telecom had two reportable segments: Wireless and Wire line. ABC Telecom, together with its wireless affiliates, provides digital wireless services in all 50 states, Puerto Rico and the U.S. Virgin Islands under the ABC Telecom brand name, utilizing wireless code division multiple access (CDMA) technology. In addition, ABC Telecom provides digital wireless services under the New Tel and *XYZ Mobile* brand names using Digital Enhanced Network (*iDEN*) technology. ABC Telecom is also a provider of long distance services and a carrier of Internet traffic in the US.

1.3 Challenges

With emerging technologies, it is very important to keep up to date and provide new offerings with innovative features to attract and retain customers. Because of the saturation of the wireless phone market, the only way to increase the customer base is to offer devices and services that are more attractive than those offered by the competitors and at the same time be first to market. To be innovative and first to market with products and services that are of high quality and meet customers' expectations, ABC Telecom has decided to adopt the scrum framework for one of its new products. The biggest challenge ABC Telecom is facing in adopting scrum methodology is how to implement scrum in a distributed environment where the workforce is not located at one place but scattered across the continents.

2. Literature Review

The scrum methodology has been used in the industry since its inception in 1993. Research shows that the success rate of projects implemented using scrum methodology depends on how organizations implement the principles of scrum, the adaptability of the management to scrum processes, and the understanding of scrum principles by the team. Scrum is a very simple framework within which the “game” of complex product development is played. Scrum exposes every inadequacy or dysfunction within an organization’s product and system development practices. The intention of scrum is to make these issues transparent so the organization can fix them. Unfortunately, many organizations change scrum to accommodate the inadequacies or dysfunctions instead of solving them (Schwaber 2008).

A small project with some amount of complexity is manageable through a central control system, but as the project size and complexity increase, it becomes necessary to delegate responsibilities and decision making to people doing the actual work. The scrum methodology not only moves the control from central scheduling authority to individual teams doing the work, but also shortens the feedback loop between customer and developer (Schwaber 2004). In a complex system, there are more unknowns than known and learning through short cycles of discovery is the way to investigate and find the answer to unknowns. Scrum methodology increases the probability of a higher software development success rate.

Transitioning from a traditional waterfall approach for project management to the scrum framework is hard but worthwhile. The end results of adopting the scrum methodology are

higher productivity and lower cost, improved employee engagement and job satisfaction, and faster time to market. A survey from the industry shows that 82% of the participants felt that the productivity was higher after adopting scrum methodology. The survey also shows that scrum teams tend to release their products to market at least 41% faster than traditional teams (Cohn 2009). The increase in productivity leads to cost savings. The employees are more engaged in their work and have an overall better job satisfaction as they have more control of their day-to-day work, they see their work in action after each iteration, team members are working more closely to their coworkers, and the products produced are more likely to meet customer expectations.

The enterprise needs a new culture as scrum embraces change, unpredictability, and complexity. With scrum, a vision of the project's value is projected in a base plan. The project moves forward iteration by iteration toward the vision. Iteration is known as sprint in scrum. Increments are inspected at every sprint. Adaptations are then made to the project to optimize the likelihood of realizing the value to the customer (Schwaber 2007). Before adopting scrum, it is very important to assess the type of change that will occur at the enterprise level. It could cause change in compensation policies because in the scrum framework, the team is awarded as compared to individuals. Jobs and responsibilities will change and some existing jobs will disappear. Career paths for individuals become far less important than the contribution to the team and the enterprise. Management's role will change from command leadership to servant leadership. Management turnover will occur as the managers might not like the new way of working or managing.

The main objectives that scrum helps to achieve are as follows: a systematic risk reduction mechanism, a linear project lifecycle, a more adaptive project management process, and a framework based on people's motivation and pride (Pham 2011). The use of scrum methodology empowers the team members to take responsibility of a work item assignment, estimate the work effort needed to complete the work, and commit to delivering the task on time. Scrum also enforces project management techniques for the team to involve the customers by getting their feedback regularly to ensure that product development is heading in the right direction and meets customer satisfaction.

A product vision is based on the customer needs and product attributes. Thus, special attention needs to be paid to communication in order to derive a vision that can be achieved through well defined goals. Scrum provides the process and techniques in defining the vision for the product, but it needs dedicated involvement from the product owner, management, and the team. At first, the product backlog will contain deliverables, such as "Prototypes exploring user interface design options available" and "Customer interviews are carried out." As the work progresses, the product backlog will include the high-level attributes that describe the future product, according to the product vision. Each visioning sprint will create an increment that forms a step toward achieving the goals (Pichler 2010).

The biggest challenge to overcome when implementing Scrum in distributed teams is that of communication. In daily Scrum meetings, person-to-person communication is a valued part of the process as working directly with one another reinforces the importance of teamwork. The team can truly bond, and work toward achieving the shared goal (O'Connell 2010).

Accordingly, it is important to have latest communication tools available to all the team members to overcome the communication challenges in a distributed team environment. Video and phone conferencing, web cams, instant messaging software, desktop sharing, and email play an important role to stay connected to the team members regardless of their location.

In addition to communication, other challenges facing distributed teams are language differences, technical incompatibilities, project management issues, poor engineering practices, schedule differences, and peer dynamics. Each of these challenges can affect the team's performance. In a traditional waterfall development fashion, a team of specialists wait for their work assignments and it might be tempting to let some of these challenges go and see if they work themselves out. However, in an agile environment, the scrum team pulls the highest-priority work and works together throughout the development process, which brings these challenges to the forefront. Scrum does not solve the problems with distributed teams, but it puts a spotlight on them so the team can identify and address them in a timely manner (Woodward, Steffan, and Ganis 2010). Scrum prevents the team from overlooking these problems and challenges that quietly drain performance from the team.

Research has proven that even large projects with time and budget constraints can be successfully implemented using scrum methodology. With an excellent implementation of scrum, distributed teams and even outsourced teams can be as productive as collocated teams. The entire set of distributed teams must function as a single team with one global repository, one reporting and tracking tool, and daily scrum meetings across the board. To achieve high

productivity, all teams must be controlled from a central site and outsourced teams must be highly skilled agile teams (Sutherland 2007).

The industry research discussed above shows that scrum methodology has several advantages compared with a more traditional development approach. Scrum helps identify the issues in the early stages of the development process and provide the opportunity to fix the problems sooner, which in turn helps reduce risk. Scrum helps break down the work into small releases, shortens the customer feedback time, increases productivity, improves employee engagement and job satisfaction, and results in faster time to market. However, the research also shows that there are some challenges when it comes to implementing scrum methodology with teams that are distributed, and also suggests means to overcoming these challenges. An important observation that comes out of this research is that the mindset of people in the organization at different levels needs to be changed to see any fruitful results of adopting scrum methodology.

3. The Scrum Methodology

“Scrum is not a methodology – it is a pathway” - Ken Schwaber, 2005

Scrum is an agile process that allows the team to focus on the highest priority business requirement and complete it in the shortest amount of time to be first to market. The business comes up with a set of prioritized tasks, and the team decides the best way to design and complete the task in the shortest amount of time. It allows the client to see actual working software every two weeks to a month and provide feedback. Based on customer feedback, necessary changes are made in the next iteration, or sprint.

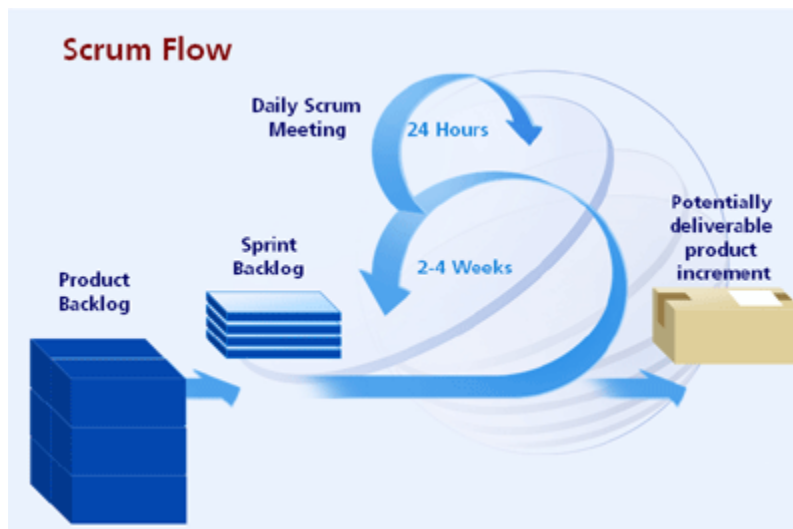


Figure 1 - Scrum Flow (Schwaber 2005)

In scrum, the teams are self-organizing. Rather than doing one thing all of the time, team members do a little of everything all the time. Scrum projects are completed in iterations called sprints. The duration of a sprint is between 2-4 weeks or a month at a maximum. It is better to keep the length of each sprint the same. The tasks assigned to a sprint are designed, coded, and

tested during that sprint. However, based on the progress, the tasks can be added or removed from the sprint to complete the sprint on time.

Scrum follows the basic agile values:

The Agile Manifesto—a statement of values

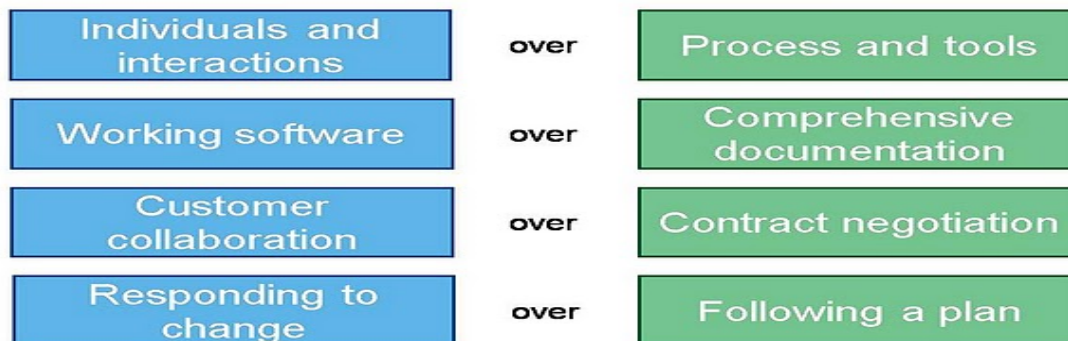


Figure 2 - Agile Manifesto (Beck 2001)

Scrum has 5 underlying principles that underpin its framework:

- **Empiricism** – Make decisions based on observation and experimentation and not theory; that is, replace detailed up front planning and processes by just in time inspect and adapt cycles.
- **Self Organization** – Allow the teams to self manage and be autonomous; allow them to organize themselves around clear goals, objectives and constraints.
- **Collaboration** – Collaborate with the team, do not manage or direct them.

- **Prioritization** – Work on the most important thing first; that is, do the things that add the most value to the project, and don't waste time working on things that do not add immediate value.
- **Time Boxing** – Set time boxes and stick to them; do not extend them. Time boxes create the rhythm that everyone can work to.

Just like the scrum values, the principles of scrum are fundamental to its success (Schwaber 2005).

3.1. Scrum Roles

3.1.1. Product Owner

The product owner is the final authority on the requirements of the product. The product owner is responsible for the product vision and improving return on investment (Reynolds, 2010). Since product owners finalize the requirements, they are the ones that evaluate and approve the work done at the end of each sprint. The product owner is not part of the team, but works closely with the team. Product owners also work very closely with the users and the management to ensure the goals that are outlined at the start of the project is met. It is the product owner's responsibility to do release planning, prioritize the work, and communicate to the users and the team regarding the work that would be delivered at the end of each sprint. The product owner is an individual with the most authority and also the most responsibility. In other words, if a project does not go as planned, then the product owner is the one who takes the heat from both the management

and the clients. Therefore, the product owner's involvement in the project should be such that he or she is available to answer any questions from the team but at the same time avoids micromanagement.

3.1.2. Scrum Master

The scrum master is a facilitator and works with the product owner and the team to ensure that the scrum values, practices, and rules are understood and adhered to. The scrum master is not part of the team. The scrum master's main responsibilities are the following: keeping the team focused on achieving the goals of the sprint on time, teaching the team members to learn and grow as problem solvers and take responsibility of their work, enforcing the rules of the agile manifesto, and managing conflict resolution within and outside the team to ensure on time delivery of the product promised (Schaub 2010).

The scrum master's responsibilities are different from a traditional project manager in that instead of assigning the work, the scrum master ensures that team members are more independent in taking on responsibilities, managing, and becoming accountable for their own actions. The scrum master enables close cooperation across all roles and functions as well as helps remove any roadblocks that may affect the team and ensures on time delivery of the work. The scrum master acts as a liaison between the product owner and the team and also advises the product owner on ways to maximize ROI for the team.

3.1.3. Team

The team consists of 5 to 9 cross functional members. The members of the team should be full time and devoted to the sprint. However, they may leave the project after a sprint is over (Schaub 2010). The team takes the functional requirements and converts them to system requirements, provides time estimates for the tasks in a sprint, comes up with the design and implementation techniques, and monitors the progress of their work with the help of the scrum master. Since the team is doing lot of activities, members of the team should have experience in varying disciplines such as design, estimation, implementation, and testing. Members of the team should assume responsibilities in taking the ownership of the work from the product backlog that needs to be completed, provide the work status to the scrum master, and track the progress of the work. Scrum provides team members freedom for determining how they will accomplish the tasks, but this freedom is accompanied with the responsibility to meet the goals of the project. Team members should be willing to cross train other members so that the team becomes better-rounded as the time passes and the project moves smoothly from one sprint to the next.

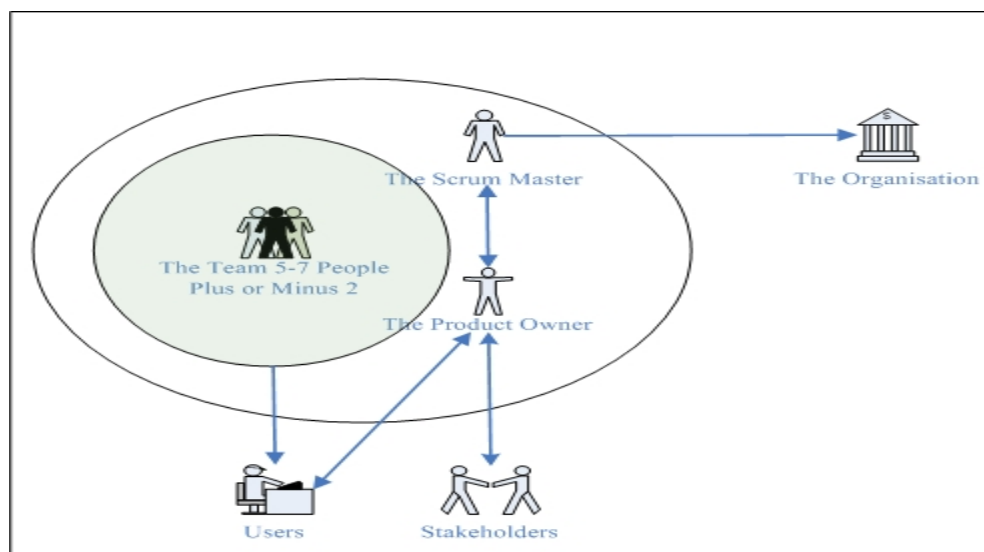


Figure 3 - Scrum Relationships (Reynold 2010)

3.2. Scrum Artifacts

3.2.1. Product Backlog

The product owner is responsible for maintaining the product backlog. The product backlog is a list of requirements in a prioritized sequence. This is a living document that can be changed and re-prioritized to accommodate client requests. The product backlog has four qualities: It is detailed appropriately, estimated, emergent, and prioritized (Pichler 2010).

The product backlog is the “What” of the system (Reynold 2010). In a product backlog, the requirements are described in detail; however, the high priority requirements have more detail than the lower priority items. The details help estimate the level of effort needed to accomplish the task. Estimating each item in the product backlog helps prioritize the work. The product backlog evolves based on new requirements and user feedback after each sprint. All requirements in the product backlog are prioritized by the product owner as it helps in deciding which tasks to accomplish in which sprint. The highest priority tasks are planned for the upcoming sprint and so forth.

A sample product backlog

Backlog item	Estimate
Allow a guest to make a reservation	3
As a guest, I want to cancel a reservation.	5
As a guest, I want to change the dates of a reservation.	3
As a hotel employee, I can run RevPAR reports (revenue-per-available-room)	8
Improve exception handling	8
...	30
...	50

Figure 4 - Product Backlog (Reynold 2010)

3.2.2. Sprint Backlog

The sprint backlog is the “Why” of the system (Reynold 2010). The sprint backlog contains all the tasks along with time estimates for each task to be completed in a particular sprint. This document or artifact is created in a sprint planning meeting and updated as needed based on the outcome of the daily scrum meeting. The tasks in the sprint backlog must be selected by the team, as the team members are the ones committed to complete the tasks within the sprint time frame.



Figure 6 - Sprint Backlog tasks on the wall (Deemer 2010)

Tasks from the sprint backlog can be deleted or new tasks can be added as sometimes too little or too much work is pulled into the sprint.

Generally, the sprint backlog is maintained in an Excel spreadsheet, but some teams like to use a white board, put sticky notes on the wall or use software specifically designed for scrum.

A sprint backlog

Tasks	Mon	Tues	Wed	Thur	Fri
Code the user interface	8	4	8		
Code the middle tier	16	12	10	4	
Test the middle tier	8	16	16	11	8
Write online help	12				
Write the foo class	8	8	8	8	8
Add error logging			8	4	

Figure 5 - Sprint Backlog (Reynold 2010)

3.2.3. Burn Down

The burn down chart is used to track the work needed to be completed in the sprint. This chart is updated every day and helps in monitoring the progress of work. The horizontal axis represents the time in days while the vertical axis represents the work remaining in hours. It is recommended to display this chart prominently to give the team a clear picture of the progress of the tasks accomplished and the work at hand. The burn down chart can be at the sprint level as well as at the product level. In an ideal scenario, the chart should burn down to zero at the end of each sprint if the work estimate is done correctly and adjusted as the sprint progresses.

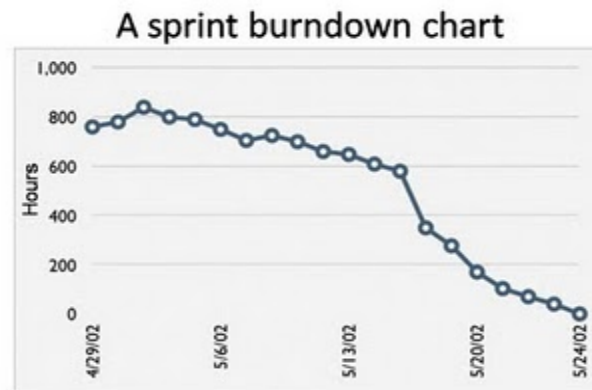


Figure 7 - Burndown Chart (Reynold 2010)

3.3. Scrum Meetings

3.3.1. Sprint Planning Meeting

The sprint planning meeting is a negotiation between the team and the product owner about what the team will do during the next sprint. The product owner and all team members agree on a set of sprint goals, which are used to determine which product backlog items from the uncommitted backlog will be committed to the sprint (Szalvay

2007). New sprint backlog items are defined during the meeting. After the sprint backlog is created, the team will work on the estimates and get clarification from the product owner about tasks that can affect the estimates. The team then works with the product owner to renegotiate the tasks that can be accomplished within the sprint time frame. Sometimes, teams insert placeholder tasks (with rough estimates) for the product backlog items they don't expect to start working on until later in the sprint. Once the sprint backlog is finalized and agreed upon by the product owner and the team, the team can start on the design and construction of actual product.

3.3.2. Daily Scrum

This is a 15-minute long stand up meeting held first thing in the morning in which each team member answers the following three questions (Pichler 2010):

1. What have I done since the last scrum meeting?
2. What will I do before the next scrum meeting?
3. Are there any roadblocks?

It is important to remember that this is not a problem solving session. If team members run into any roadblocks, they let the whole team know about them and then work offline with the team or the scrum master to get answers to solve the issues.

3.3.3. Sprint Review Meeting

In the sprint review meeting, the team presents the tasks completed in the sprint. This meeting is time-boxed to 4 hours at the end of each sprint. It is more of a demo of the

functionality that was completed and unit tested. The demo is for the product owner and any other interested parties. Only completed product functionality can be demonstrated. The prep work for the meeting should be kept to a minimum. The meeting should be low-key, and not a show. Teams should refrain from giving a formal presentation and avoid using slides. The purpose of the meeting is not to impress or to create excitement but to provide transparency, and to inspect and adapt the product. It enables more hands-on time for the stakeholders (Pichler 2010).

This meeting helps establish a good communication channel between the customer and the team. Individual team members and stakeholders directly communicate in depth, which creates an improved vision for the product.

3.3.4. Sprint Retrospective

The sprint retrospective meeting is held at the end of every sprint after the sprint review meeting. The team and scrum master meet to discuss what went well and what to improve in the next sprint. The product owner does not attend this meeting (Szalvay 2007). It is extremely important to hold this meeting and for all the team members to participate without exception. This meeting helps in finding the issues that may affect the timelines and assists the scrum master in taking these issues as action items to work on so that the next sprint goes more smoothly. This is kind of a “lessons learned” exercise in which the team identifies the processes or aspects that worked well and those that need improvement.



Figure 8 - Scrum Methodology (Reynold 2010)

As discussed above, scrum methodology defines very clearly the roles of the individuals in an organization and on the scrum team, the meetings that need to take place to have effective communication that helps achieving the goals, and the artifacts that are needed throughout the project to track not only the progress of the project but also provide the insight into what is working as expected and where there is room for opportunity. These roles, meetings, and artifacts are part of any project that implements scrum methodology regardless of whether the team is collocated or distributed across continents. Let us now look at the challenges ABC Telecom is facing and see how scrum methodology can be applied to ABC Telecom's distributed teams to help overcome those challenges.

4. Scrum Application at ABC Telecom

4.1.Threats

ABC Telecom is facing the following internal and external threats that will have an impact on their bottom line if not dealt with immediately:

4.1.1. Overall Economic Conditions

Right now the biggest threat to all industries, including the telecommunications sector, is weak economic conditions. Customers have lost their trust in economy and are not spending. The effect can be seen in huge cost reduction measures at ABC Telecom that have resulted in mass layoffs.

4.1.2. Competition

The competition in the telecom industry has become cutthroat. To capture market share and attract customers, companies have been engaged for quite some time in a price reduction war. Now it has come to a point where for some services, the cost of providing that service has exceeded the sales price. This has resulted in low profit margins.

4.1.3. Productivity and Cost Efficiency

ABC Telecom needs to work on improving cost efficiency. ABC Telecom's expenses are far greater than those of its competitors, and it is hurting ABC Telecom badly. In current

economic conditions, without cost efficiency and productivity it is really difficult to survive. To overcome this issue, ABC Telecom has no other option right now other than making the difficult decision to reduce its workforce.

4.1.4. Innovation

With emerging technologies, it is very important to keep up to date and provide new offerings with innovative features to attract and retain customers. Because of the saturation of the wireless phone market, the only way to increase the customer base is to lure customers away from other carriers with devices and services that are more attractive than those offered by competitors. To keep up with technologies, companies need to continuously invest in R&D, which can affect the company's overall profit margin. The risk is if the company stops investing due to its financial position, then it will be left chasing other carriers and competitors. ABC Telecom needs to keep looking at ways to develop new products and services and be first to market.

4.2. Initiatives

To overcome the threats mentioned above, ABC Telecom looked at success stories in the industry and decided to take the following initiatives:

4.2.1. Offshore Development

Working with distributed teams gives companies access to talent that they may otherwise not have access to locally. Additionally, when a company works with distributed teams, an organization gains experience in working with different global markets; in turn, this

type of experience can prove to be vital if the company wishes to expand its operations internationally.

Moreover, a project can be completed faster if people in different time zones are continuously working on a particular project. Last, but certainly not least, companies can obtain significant cost savings if they work within a distributed team environment (O'Connell 2010).

Working with distributed teams also gives the flexibility to decrease or increase team size without losing the knowledge base required to complete the project. It also helps in recreating the product as needed.

4.2.2. Smart Development

Working and managing product development in a traditional waterfall approach limited ABC Telecom's ability to be flexible enough to tailor the product to customers' needs within the short span of time and still be first to market. It also affected the financial aspect of the project, in an existing development environment, making changes requires redesigning and duplication of effort. This results in increasing the overall cost of the project and hence affects the financial goals.

The company's management decided to go with an approach that is more flexible and less expensive to accommodate changes to user requirements, provides faster feedback from the clients, reduces the development time, and is easy to maintain when it is

launched in the market. There were several industry success stories around the globe to convince the decision makers at ABC Telecom to adopt an agile development methodology for product management and development using scrum. Scrum provided the company with an iterative approach to deliver the product in phases get quick feedback from the clients and then accommodate the changes accordingly. Scrum has proven to help deliver the product much faster as compared to traditional approaches as well as reduce the overall cost of product development and maintenance.

4.3. Implementing Distributed Scrum

The practices and principles of scrum in a distributed environment are no different from the ones in a non-distributed environment. However, the distributed environment does present some challenges because of the distance and differences between locations. These challenges are discussed below:

4.3.1. Challenges

4.3.1.1. Poor Communication

While there are technical issues that need to be considered when using scrum in a distributed environment, the biggest challenge centers around human issues, starting with communication.

Any kind of product development involves communications at different levels. The quality of the end product is directly linked to the quality of the communication that

takes place among people from the inception of the idea to the moment the product is put on the shelf (Deemer 2010). The customers provide the requirements to the development team; the development team members communicate with each other and customers to come up with the design that satisfies the customers' requirements; the customers provide feedback on whether the product features satisfy their needs. During this process, everyone communicates with one another to raise concerns, provide solutions, and show commitment to achieving the end goal.

In a non-distributed environment where the product owner and the development team are at one location, there are fewer communication challenges. It is easy to get a hold of the product owner for answers to any questions or issues that may need attention. Less time is spent on communication and more time is spent producing business value.

In a distributed environment where the product owner and the development team are at different locations, the chances of misunderstanding are high, and also time spent communicating can increase as the product owner may not be available immediately to answer questions. Poor communication could be a result of time differences or the communication tools available at both ends. The lack of good communication can result in a product that is not up to the quality expected and can also affect the project timelines and cost. Furthermore, the more effort the communication requires, the less business value will be produced; if the team has to leave 3 voicemails for the product owner to get a response to their question, the product owner will inevitably get a little less software in the end as the team was spending their time dialing and waiting, not

coding.

4.3.1.2. Lack of Trust

The other key enabler – or constraint – for distributed projects is how much trust there is between the product owner and the team. Inevitably, in the course of day-to-day cooperation, there will be bumps in the road. Miscommunication will happen, misunderstandings will occur, mistakes will be made, and myriad of other problems will come up. If there is a strong human relationship between the product owner and team, these issues can simply be taken at face value; they will remain routine misunderstandings or mistakes that can be overcome. However, if there is not a strong relationship, over time these issues tend to pile up and become “evidence” in a dark narrative about the other party: that they are incompetent, dishonest, or even crazy – or even all three (Deemer 2010).

When the entire team is at one location, it is easy to develop trust between different players and resolve any issues that come along. However, in distributed teams, especially when a product owner is located on one continent and the development team is located on another, there are more chances of having miscommunication, misunderstandings, and other misconceptions that develop due to lack of information about each other. If there is a strong human relationship between all the players, the chances of resolving and overcoming these obstacles is high and the impact to the project will be less; otherwise these problems that start out as minor problems will

result in developing a lack of trust and in effect jeopardize the overall project. Once a seed of misunderstanding is sown, it is extremely difficult to eradicate it and teamwork is replaced by a battle of egos. This environment affects the quality of the project as overall team productivity decreases because time is spent resolving conflicts rather than developing the product. There are a number of examples in the industry where projects have failed due to lack of trust between the product owner and the development team, and each party has thought that the other party is incompetent.

4.3.1.3. Inefficient Technical Practices

In addition to strong working relationships and effective communication, there are other factors that can affect productivity. These technical inefficiencies may include different development tools and environments at different locations, personnel with special expertise available at one site only, senior and seasoned manpower employed at one location and all juniors at other site, and the work distributed un-evenly in a way that the team at one location is working on a particular piece of the product all the time and has no idea of the work being done at other locations. These inefficiencies can create an imbalance in the form of ambiguity, a lack of consistency, the creation of silos, and the promotion of differences among the team.

4.3.1.4. Cultural Differences

In a distributed development environment, the focus shifts from in house face-to-face communication to more virtual communication. This presents challenges as the individuals on the team are from different nations with different social, cultural and ethnic backgrounds. Moreover, if the teams are in different parts of the world then they are also affected by the time difference. People from different cultural backgrounds have different perspectives that can affect the relationship between teams in different locations. The work ethic in one country can differ from that of another country tremendously. People from one country may be more direct in their communication whereas people from another may be more cautious. Also, in some cultures people are used to working in more hierarchical structures than people in other cultures.

All these factors present challenges in implementing scrum practices and if they are not managed up front, they can affect the project.

4.3.1.5. Team Meeting Issues

Sprint Planning Meeting: One of the practical conflicts in distributed scrum is that more time is typically needed to properly complete the sprint planning, review, and retrospective meetings than in a collocated environment, and there is often less time

available for these meetings (due to lack of time zone overlap). This is less of an issue for projects involving team members from both Europe and Asia, for example, but for those with members from both the US and Asia; it can become a real impediment to success.

Daily Scrum Meeting: If the team is collocated together, and the product owner is in a different location, the first question to ask is whether the product owner should be invited to join the team's daily scrum meeting. There are pros and cons to this. Some teams find it helpful to have the product owner join the meeting, so he or she is aware of their impediments on a day-to-day basis. It also allows a window of time after the meeting each day for live discussion with the product owner. However, there can also be downsides to having the product owner join. It often costs precious minutes each day, as either the team or the product owner waits for the other to join the meeting. Having the product owner joining the daily scrum meeting can also make the team feel like they are being monitored and overseen, and this adds pressure and stress, invites micromanagement, and can reduce the team's sense of responsibility and self-organization. Third, if due to the presence of the product owner the call has to take place in the evening hours for the team, it will hurt morale and significantly accelerate burnout, with the end result of much less business value being produced. If the product owner is anxious to know how the sprint is progressing, it may be much less disruptive to have the scrum master simply email a camera-phone photo of the team's Sprint Burn down Chart.

Sprint Review Meeting: Sprint Reviews serve the same purpose for a distributed

scrum project as they do for a collocated one: To enable the product owner and team to inspect and adapt what has been produced in the current sprint, and collaborate about what could be done next. In a distributed scrum, features may be less “right” the first time they are shown, because clear and complete communication between the product owner and the team is made more difficult by the distance between team members. This is one of the realities of distributed development, and the product owner should build into the release plan a buffer to account for the additional rework that will be required, as items are placed back onto the product backlog for improvement.

Sprint Retrospective: The purpose of the sprint retrospective is for the team, the product owner, and the scrum master to discuss their experiences and observations from the current sprint, identify issues and areas for improvement, and agree on changes to make to their way of working to produce better results in the next sprint. The more distributed the team, the more issues there will be – and thus, the more thorough and effective the sprint retrospective needs to be. The most successful scrum Teams focus on the “learning” or “experimental” mindset that scrum enables: identifying problems as quickly as possible, and then “testing” a practical solution in the very next sprint. Rather than agonizing over what is the best possible way to do something, the simplest thing that could work should be tried for a sprint. Shorter-length sprints may accelerate these improvements, by enabling more rapid cycles of inspection and adaptation.

4.3.1.6. Artifacts Mishandling

In a distributed scrum project, more written artifacts will typically be used, but just how much and what format should be left to the product owner and team to determine. This should not be taken to mean that the written detail is all that is required. Indeed, the presence of more written detail will often mean that more conversation – not less – will be required between the product owner and team to achieve an effective shared understanding. The additional written detail simply gives the team a reference tool for answering questions when the product owner is not immediately available.

4.3.2. Solution

After doing research in the industry, ABC Telecom took the following steps to make Scrum methodology work in its distributed environment where the team members are located in the US and India.

4.3.2.1. Effective Communication

Research has shown that the level of communication can be put on a richness scale as shown below:

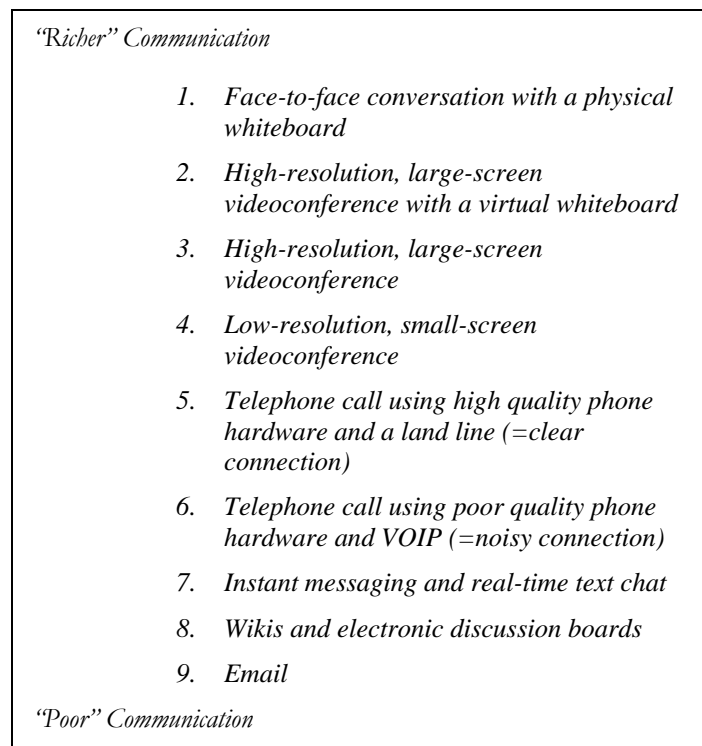


Figure 9 – Communication Richness Scale (Deemer 2010)

By and large, the higher up on this scale that the company is, the richer and easier the communication, the more natural the interaction and the more immediate and

faithful the understanding between people (Deemer 2010).

ABC Telecom took the following steps to overcome the communication bottlenecks by studying the above communication effectiveness tools:

One of the main observations by looking at the effectiveness of various communication tools outlined above is that email is at the bottom of the list, which means it is the least effective mode of communication. The scrum master emphasized the team should get away from using email as the primary mode of communication. In effect, the preferred mode of communication should be live. The team members were allowed to make telephone calls if needed or use Instant Messenger to get answers to any questions. For this purpose a contact list of all the team members was placed on the share point and included desk number, mobile number, instant messenger user names, and the afterhours time period during which calls could be received for urgent issues.

For all scrum meetings such as sprint planning, product backlog, sprint review, and sprint retrospective, ABC Telecom decided to implement video conferencing in which team members from remote locations could log in and participate. This tool helped ensure all participants' complete involvement in the task discussed without interruptions and helped to overcome the issue of unfamiliar accents as looking at the facial expressions and body language makes the speaker easier to understand.

ABC Telecom invested in software that allowed the team members to share their desktops to participate in live meetings. It also helped in presenting the demos to the

clients and getting their feedback. The software really helped in saving a lot of time that would have been spent going back and forth using emails; instead all decisions were made on the spot as all the participants were available to provide input and receive feedback. This tool not only helped in meeting deadlines but also improved the quality of product developed.

The following diagram shows a conference room with an ad-hoc setup for live meetings, with two projectors side-by-side (one projector displaying the Skype video feed from the other location, and the second projector displaying the shared desktop or virtual whiteboard), plus a high-quality conference phone on a land-line.

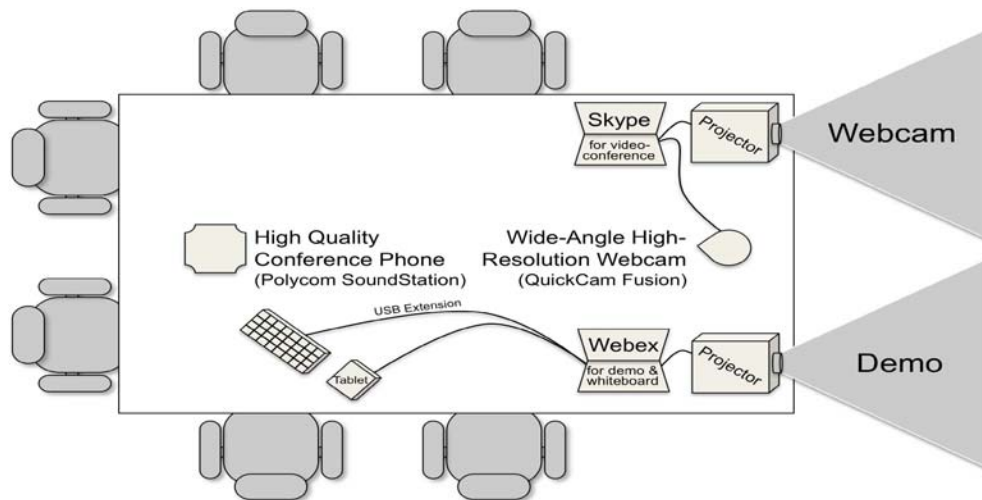


Figure 10 - Conference Room Set Up for Live Meetings (Deemer 2010)

Great software is typically produced only when there is great communication between the people involved, and poor communication will limit the quantity, quality, and correctness of the end result (Deemer 2010).

4.3.2.2. Building Trust

To establish an environment where there is an element of trust among the product owner and the team, ABC Telecom decided to bring the whole team together at one place so that everybody could meet face-to-face at the beginning of the project. Since the product owner is in the US and the development team is overseas, it was decided that the product owner travel overseas and stay there for couple of weeks. This helped product owner and the team spend some quality time with one another and discuss the project vision and goals. This also provided the opportunity for the product owner to better understand the perspective of individuals on the development team, cultural aspects, and ethnic needs. It helped the team to become more comfortable communicating with each other and provided the development team the opportunity to ask questions to the product owner about the product backlog and the expectations. The product owner also got the opportunity to discuss and communicate more clearly the customers' expectations.

This proved to be a very successful exercise in developing mutual trust, as later in the project when the product owner was communicating to the development team and vice versa, they could understand each other's perspective more clearly, and felt more comfortable that the message was being communicated clearly from either side.

4.3.2.3. Efficient Technical Practices

To overcome the technical difficulties, ABC Telecom made sure that the team

members in the US and India had access to the same software, development tools, and servers. ABC Telecom also ensured at the time of hiring that a mix of seniors and juniors were available at both development locations. ABC Telecom went to the extent of dividing the work in a way that the architecture and design decisions were made by getting input from the architects and the designers available at both the locations. ABC Telecom also ensured that the development of different layers of product was also evenly distributed among the team so that all the team members developed the feeling of contributing to the overall product and no silos developed.

ABC Telecom also realized that in order to catch any issues in the earlier stages of development it was really important to integrate the work done at different locations regularly at short intervals. For this reason the development team was asked to check in their changes daily, and a nightly build was made to combine the changes at the end of the day. It was ensured that the build did not break anything in the code, and if the build did break, no new changes were allowed to be checked in until the previous errors were resolved. This helped in building an error free code and catching and resolving issues that may have occurred early on rather than waiting until the end of the sprint.

ABC Telecom also provided the team members with the Team calendar, showing release dates, sprint dates, local holidays, and vacation plans. Team mailing lists were also setup so all the communication could be made easily to concerned people on the team. Also, when a build was done, an email alert was sent to the team at the end of the day to inform the team about the progress of the build.

4.3.2.4. Managing Diversity

The first and most important factor to counter cultural differences is good personal relationships. ABC Telecom ensured good personal relationships by conducting live meetings daily. Another initiative that helped in this regard was that the team was provided a culture of openness and direct communication. This culture was achieved by encouraging team members to talk to the members of the team located at other location via phone and avoid email communication as much as possible. This helped bring out issues during retrospectives and lowered communication barriers. Finally, a company culture of openness with an equal value system on both sides supported the team culture and made associating with each other easier.

4.3.2.5. Managing Meetings

To overcome the issues facing the team during scrum meetings in a distributed environment where the team is distributed between the US and India, ABC Telecom chalked out the following process for the meetings held during different phases of the scrum implementation:

Daily Scrum: Since the teams for ABC Telecom are in the US and India where there is a time difference of 11 hours, it was not possible to hold the daily scrum meeting at a working hour that overlapped, so the scrum master had to be more

inventive. At first it was decided that a live scrum meeting would be held at each location on alternate days and that meeting would be recorded, and the team at the other location would have access to the recording and could view it at the start of their workday. In the beginning it seemed to work, but after few days it became evident that since the teams from both locations were not present at the same time, a lot of questions were not answered on time and a lot of time was spent in writing emails and making phone calls to understand the status of the team members. After putting some thought into the problem and gathering input from all the team members, the team decided unanimously to hold the daily scrum meeting live via webcam or conference call each day at an hour that was convenient for one side or the other. The scrum master made sure to rotate the burden of the inconvenience from one side to the other every week or two. Further, the core working hours were adjusted to make sure it did not become an inconvenience for the families of the team members.

Sprint Review: The scrum master made sure that the sprint review meeting was held when the entire team was available regardless of the location so that individuals in the team felt that their input was valued, and also provide them the opportunity to listen to the information or feedback firsthand. It was encouraged that when it was time to demo the functionality of the product developed in a particular sprint, the team members from both onshore and offshore were both given the opportunity to participate. This helped in making sure that the whole team received the recognition, and all the team members were treated equally regardless of the location.

Sprint Retrospective: ABC Telecom's scrum master made sure that the sprint retrospective meeting took place when the product owner and the entire development team were present. There might have been issues or concerns that were raised during this meeting, and if either party was not present, the chances of establishing misconceptions and disconnect were likely to be high. An ineffective meeting could damage long term relationships in the long run. The scrum master also made sure that this meeting was held using audiovisual equipment so that team members' facial expressions as well as body language could be observed, to better understand the feelings of team members when they made comments or raise concerns.

4.3.2.6. Managing Artifacts:

Successful implementation of scrum methodology in distributed environments suggests that with distributed scrum teams, the aim is to share a common vision and break the work into small packages that are easier to inspect and adapt, thus reducing confusion and identifying misunderstandings sooner (Deemer 2010). Product Backlog Items should be short and easy to understand, with clear conditions of satisfaction attached. Pictures in the form of sketches, diagrams and simple mockups can convey a lot of information quickly. While User Stories are a popular and effective format for articulating product backlog items, lightweight use cases can also work well. Some teams have found that having a demo server in which the product owner can review functionality on a daily basis can help keep everyone in sync and aligned and reveal misunderstandings sooner.

ABC Telecom decided to manage scrum artifacts (for example, the sprint backlog and sprint burn down chart used by the team to manage their work during the sprint), by placing them on a share point. A Share point is a place on the web within the organization that is accessible only to the employees of the organization where all the documents can be uploaded and is available for view by all the team members all the time. A trigger is also set to make sure whenever the document is updated by the document owner, an email is sent to the entire team to communicate the change activity. This tool helped the scrum team to stay on top of any changes made to the document. All the documents on the share point are living documents.

This is a very secure way of maintaining and sharing information among distributed teams. Since the location of the documents is only accessible by the authenticated users, there is no threat of illegal access. Also, a backup is taken every night in case the server crashes and data is lost. Another advantage is that the documents on the share point can only be updated by the owner of the document, and the ownership is set initially when the document is uploaded to the website. This prevents unauthorized users from changing the information in the documents.

When a virtual meeting is held in which teams from ABC Telecom at different geographic location participates, the product owner or the scrum master can open the document under discussion from the share point, ensuring that the entire scrum team is viewing and discussing the same version of the document. Any decisions made regarding product backlog refinement can be made during the meeting by the product

owner in the presence of the entire team and all the parties can signoff online by agreeing upon the changes. The document can be versioned and signed and saved in presence of the concerned parties. This has helped ABC Telecom to manage artifacts much more easily without running into the scenario in which different teams located in different parts of the world have different versions of documents. It has also helped the development team and the client to stay on the same page regarding the expectations of the client and the features developed by the ABC Telecom development team.

5. Summary

Scrum methodology defines very clearly the roles of the individuals in an organization and on the scrum team, the meetings that need to take place to have effective communication that helps achieving the goals, and the artifacts that are needed throughout the project to track not only the progress of the project but also provide the insight into what is working as expected and where there is room for opportunity. Scrum methodology has several advantages compared with a more traditional project management approach. Scrum helps identify the issues in the early stages of the development process and provide the opportunity to fix the problems sooner, which in turn helps reduce risk. Scrum helps break down the work into small releases, shortens the customer feedback time, increases productivity, improves employee engagement and job satisfaction, and results in faster time to market.

Scrum methodology provides a good framework for managing product development, but it must be adjusted to accommodate the needs for distributed teams. Although the principles of scrum, empiricism, self-organization, collaboration, prioritization, and time boxing stay the same regardless of whether the team is collocated or distributed, the implementation of these principles must be adjusted to accommodate differences in team members' geographic locations. The challenges of communication barriers, lack of trust, technical inefficiencies, and mismanagement of meetings and artifacts become more evident in distributed teams as compared to collocated teams. However, as suggested in the research above, if proper measures are taken by the organizations to overcome these challenges, the outcome is fruitful regardless of the location of the personnel. ABC Telecom is seeing the results of

implementing scrum methodology for product development. Scrum has helped ABC Telecom keep on top of changing business conditions as it has helped in delivering high value software features in a short period of time. The scrum framework has allowed ABC Telecom to create a product that fulfils the customer's highest value requirements defined in product backlog by the product owner. The customer is also happy and feels engaged in the development process because this approach encourages the development team to communicate both problems and the progress of the project to customer. Further, the customer can provide feedback in a timely manner to accommodate any changes in the sprints ahead.

ABC Telecom started using scrum methodology with one project. By looking at the outcome in terms of monetary savings, beating the competition to market, and above all customer satisfaction, ABC Telecom has decided to implement the scrum framework companywide in phases.

6. Suggestions for Additional Work

At ABC Telecom, the product development team is based at two physical locations: the US and India. It was cost effective and easy for the product owner to travel to India and spend a few weeks with the offshore team members and develop a good relationship that helped during the project. However, if the development team is spread out in more than two countries, then how would the product owner manage to build personal relationship with teams at multiple sites, and what would be the financial impact? This question could be an area of research.

Another area of research could be how to implement scrum methodology in a distributed environment with one team working on multiple projects, since in scrum the backlog can be adjusted according to customer feedback. In such a scenario, how can resources be managed to accommodate product/sprint backlog changes? This could also be a candidate for further research.

7. References

Cohn, Mike. 2009. *Succeeding with Agile: Software development using Scrum*. Upper Saddle River, NJ: Addison - Wesley.

O'Connell, Feyza. 2010. Scrum success in a distributed team environment. Scrum Alliance.

<http://www.scrumalliance.org/articles/165-scrum-success-in-a-distributed-team-environment> (accessed September 17, 2011).

Pham, Andrew. 2011. *Scrum® in action: Agile software project management and development*. Boston: Cengage Learning.

Pichler, Roman. 2010. *Agile product management with Scrum: Creating products that customers love*. Boston: Addison-Wesley.

Schwaber, Ken. 2004. *Agile project management with Scrum*. Redmond, WA: Microsoft Press.

---. 2007. *The enterprise and Scrum*. Redmond, WA: Microsoft Press.

Sutherland, Jeff. 2008. Fully distributed Scrum: The secret sauce for hyperproductive offshored. Paper presented at Agile, 2008.

---. 2007. Distributed Scrum: Agile project management with outsourced development dreams. Paper presented at the proceedings of the 40th Hawaii International Conference on System Sciences.

Szalvay, Victor. 2007. Glossary of scrum terms. ScrumAlliance.

<http://www.scrumalliance.org/articles/39-glossary-of-scrum-terms> (accessed September 23, 2011).

Woodward, Elizabeth. Surdek, Steffan. and Ganis, Mathews. (2010). A Practical Guide to Distributed Scrum. IBM Press

Reynolds, Tom. (2010). The quest for high performance – The Scrum Alliance.

<http://theagilemindset.wordpress.com/contact-me/> (accessed October 20, 2011)

8. Appendix A

8.1.Acronyms and Definitions

CDMA	Code division multiple access
IDEN	Integrated Digital Enhanced Network
Scrum	<p>Not an acronym, but mechanisms in the game of rugby for getting an out-of-play ball back into play.</p> <p>Scrum is an agile software development model based on multiple small teams working in an intensive and interdependent manner.</p>
Burn Down	The trend of work remaining across time in a sprint, a Release, or a Product. The source of the raw data is the Sprint backlog and the Product backlog, with work remaining tracked on the vertical axis and the time periods (days of a sprint, or sprints) tracked on the horizontal axis.
Daily Scrum	A short meeting held daily by each Team during which the team members inspect their work, synchronize their work and progress, and report and impediments to the scrum master for removal. Follow-up meetings to adapt upcoming work to optimize the sprint may occur after the Daily scrum meetings.
Sprint Backlog	A list of tasks that defines a Team's work for a sprint. The list emerges during the sprint. Each task identifies those responsible for doing the work and the estimated amount of work remaining on the task on any given day during the sprint.
Sprint	Iteration, or one repeating cycle of similar work, that produces increment of product or system. No longer than one month and usually more than one week. The duration is fixed throughout the overall work and all teams working on the same system or product use the same length cycle.

Product Backlog	A prioritized list of requirements with estimated times to turn them into completed product functionality. Estimates are more precise the higher an item is in the Product backlog priority. The list emerges, changing as business conditions or technology changes.
Product Backlog Item	Functional requirements, non-functional requirements, and issues, prioritized in order of importance to the business and dependencies and estimated. The precision of the estimate depends on the priority and granularity of the Product backlog item, with the highest priority items that may be selected in the next sprint being very granular and precise.
Product Owner	The person responsible for managing the Product backlog so as to maximize the value of the project. The Product owner is responsible for representing the interests of everyone with a stake in the project and its resulting product.
ScrumMaster	The person responsible for the Scrum process, its correct implementation, and the maximization of its benefits.
Empiricism	Make decisions based on observation and experimentation not theory, that is replace detailed up front planning and processes by just in time inspect and adapt cycles.
Self Organization	Allow the teams to self manage and be autonomous; allow them to organize themselves around clear goals, objectives and constraints.
Collaboration	Collaborate with the team; do not manage or direct them.
Prioritization	Work on the most important thing first; that is, the things that add the most value. Don't waste time working on things that do not add immediate value.
Time Boxing	Set time boxes and stick to them; do not extend them. This creates the rhythm that everyone can work to.